
The Integrator

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Aqua Spacecraft
Now in Action

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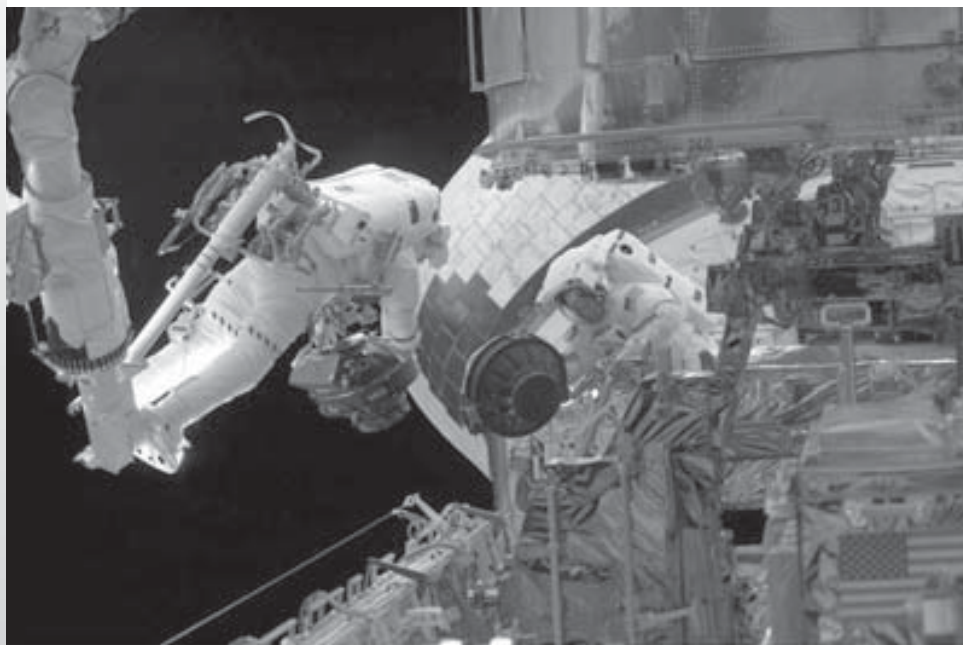
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DSMC Space Network
Transition Complete

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Latest Hubble Servicing Mission a Resounding Success!



The Mission Services Program supported the very successful Hubble Space Telescope Servicing Mission 3B (SM3B) last March 1-12, on STS-109. In this photo, taken on Day 5 of the mission, astronauts are replacing a failed Reaction Wheel Assembly (RWA), one of four such devices that point the telescope. As a result of SM3B, the Hubble now has increased scientific capabilities, revived infrared vision, and a "new" power system.

To learn more about the SM3B mission, turn to page 9.



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CODE 450 **Mission Services Program**

A Message from the Associate Director / Program Manager for Mission Services

Since the last issue of *The Integrator*, the MSP has achieved several significant milestones. MSP resources and personnel provided assistance to the very successful Hubble Space Telescope Servicing Mission 3B, conducted from March 1 to March 12. On March 8, we launched a new Tracking and Data Relay Satellite (TDRS), TDRS-I, the second of three new communications satellites designed to replace the aging, original TDRS fleet. The TDRS-I spacecraft manufacturer (with TDRS Project support) is currently working to overcome a challenging propulsion anomaly so that the spacecraft can attain the required orbit. The dedication, creativity, and hard work of this team are impressive to witness, as they work to make this mission successful. On May 4, we supported the launch of Aqua, a research spacecraft that will enable scientists to study the relationships between Earth's atmosphere, oceans, and land surface, fostering a greater understanding of global system changes. I would like to congratulate all of the MSP team members who have made these events possible, and encourage you to read more about these accomplishments in the corresponding articles in this issue.

With so many exciting events occurring, it would be easy to concentrate on the work and issues at hand, neglecting to focus on the challenges of the future. In fact, a significant number of MSP personnel are engaged in activities that will enable the MSP to meet upcoming customer needs. For example, although we are in the midst of launching a new set of TDRSs, MSP staff members are already planning the successor to that program. The TDRS Follow-on project will provide continued Space Network capability through the year 2020. We are working to ensure that this space-based communications system will effectively provide the communications capabilities required by future missions.

We are also conducting long-range architecture planning for the Ground Network (GN). For this study, engineers are baselining the current GN architecture, examining the space communications market for mission and provider trends, identifying potential strategies in response to the trends, and defining strategic implementation roadmaps for those strategies.

In addition, there is a series of activities underway in the MSP specifically designed to enable future concepts such as sensor webs and the "Space Internet." We are developing high-rate data transfer methods, investigating ways to expand Ka-band capabilities, and making plans to expand the Demand Access System (DAS) beyond the system that is currently under development. Implementation of these upgrades and new technologies will maximize the science return and increase the ease of operations for our customers.

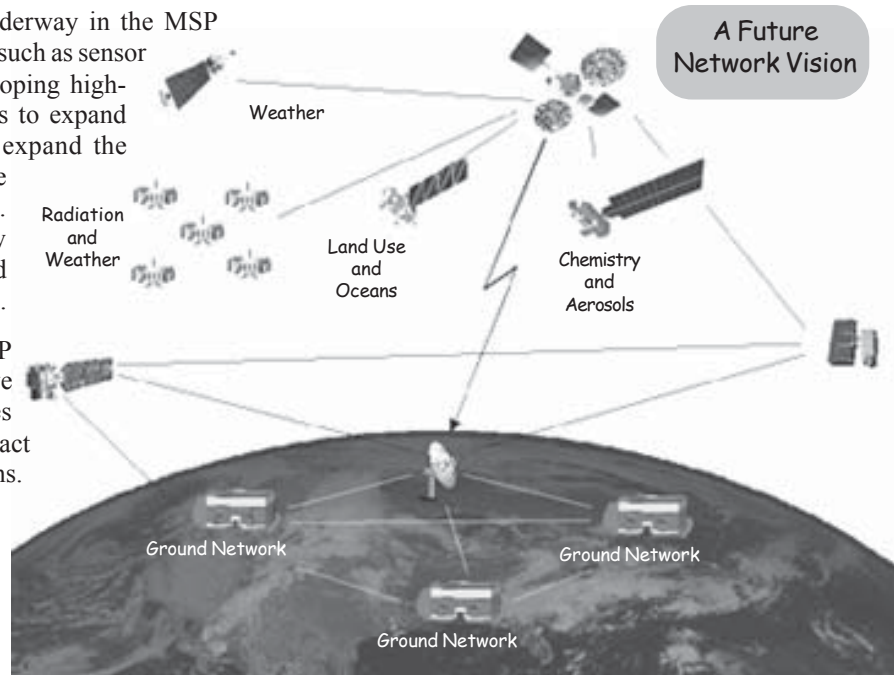
So as you read about the many MSP accomplishments of today, rest assured that we are also actively planning to meet the challenges of tomorrow. As always, please feel free to contact me with any of your ideas, questions, or concerns.

Phil Liebrecht

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Email: Philip.Liebrecht@gsfc.nasa.gov





CODE 450

Mission Services Program

TDRSS Follow-on in the Works

The Tracking and Data Relay Satellite System (TDRSS) is a national resource providing communications capabilities to numerous Low Earth Orbiting (LEO) spacecraft, expendable launch vehicles, the Shuttle, and the International Space Station. Since the late 1980s, TDRSS has provided its customers with an unparalleled level of service. With the implementation of the TDRS H, I, J (a set of satellites that will replace the aging original fleet of TDRS) the lifetime of this communication system will be extended until 2014 or 2015. But what will happen after that?

There is a definite need for a "TDRSS-like" communications constellation after TDRSS. NASA's current plans include Space Shuttle and Space Station operations until at least 2020. In addition, several future missions are planning to take advantage of the Demand Access System (DAS) that will be available on TDRSS in 2003. These missions will require a communications network similar to TDRSS throughout their functioning life cycles.

The Mission Services Program (MSP) has already started working to meet this critical future need. Two initiatives are currently underway in the MSP regarding a follow-on program to TDRSS. In the first initiative, MSP representatives are meeting with other government agencies to determine if they can jointly develop a space-based communications network system. Under the auspices of the National Security Space Architect, NASA is working with the Department of Defense and other agencies to investigate the feasibility of sharing technology and resources. In this age of dwindling budgets, it may be inefficient for each agency to operate its own space-based communications system.

In a parallel initiative, NASA is getting ready to put together a team of its own to study the potential of a NASA-unique system to replace TDRSS, in case a joint venture with other agencies will not fulfill NASA's needs in a cost effective manner. The MSP has requested money in this year's budget for this endeavor, and will be seeking personnel to fill two new positions—a system architect at the Program level and a formulation manager. These individuals will be crucial members of the TDRSS follow-on team, defining the relay architecture and services, and leading the team in developing the spacecraft specifications that will meet those

needs. The remaining team members will consist of civil servants and contractors, matrixed in from other organizations as necessary to produce the needed skills set.

It takes years to plan and execute a project of this scale and complexity. All of this advanced planning will enable the MSP to be ready to meet its customers' needs well into this century and beyond.

For further information on the TDRSS Follow-on project, please contact Roger Flaherty/GSFC Code 450 via telephone (301-286-7028) or email (Roger.J.Flaherty.1@gsfc.nasa.gov).

MSP Undergoes Internal Audit

In May, the Mission Services Program (MSP) participated in an annual Internal Audit for compliance with the GSFC Quality Management System (QMS). Mr. Stanley Iarosis, the head of the Assurance Management Office (Code 303), led the audit, which encompassed the entire MSP. The auditors met with the Program and Project Managers, our Configuration Management support contractors, Product Design

Be sure to check out the Mission Services Milestone Chart in the center of this issue.

We have updated it to reflect current dates and activities.

Further updates to this chart will be provided in future issues of The Integrator.

Leads (PDLs), and randomly selected staff members.

The audit went quite well, with no Non Conformance Reports issued against MSP for the second year in a row! Nine Observations were written—two positive and seven negative—and the negative Observations will be resolved prior to the upcoming registration audit in August. The registration audit is a full-blown audit of GSFC and Wallops Flight Facility, and is held every three years as part of the Center's ISO 9000 certification.

I would like to thank everyone for his or her efforts during this internal audit. Special thanks, however, go out to Karen Snyder, Polly Lynn, Reggie Brooks, and Raeann Lowman. The auditors positively recognized their Configuration and Directives Management efforts in an Observation. Finally, special thanks go to Tom Gitlin and Tom Sardella. As PDLs, they received special attention from the auditors, and they showed that their products are being developed in accordance with the QMS.

By Kevin Mc Carthy/ GSFC
Code 450

For additional information about this subject, please contact the author via telephone (301-286-9516) or email (kevin.mccarthy@gsfc.nasa.gov).

Spectrum Management Alleviates Interference

The Demand Access System (DAS) is scheduled to become operational some time in the next six months (see article about DAS on page 22). Some of the missions expected to use DAS include Swift, the Gamma Ray Large Area Space Telescope (GLAST), and Global Precipitation Measurement (GPM). DAS utilizes the TDRS multiple access channel at 2287.5 Mhz (which is spread with a nominal 3 Mcps code) and new, dedicated receivers at the White Sands Complex (WSC). Because of the spreading, the DAS signal energy spills over into the DSN 2290-2300 Mhz band, creating an interference issue with Deep Space Network (DSN) missions which use these channels for critical events and recovery operations (if needed). This problem has existed since the inception of the TDRSS, but is now considered more critical because of the 24x7 nature of the DAS service.

The current NASA Fourth Generation Transponder essentially has little filtering to minimize the spectral energy at 2290 Mhz and above. In previous situations, Radio Frequency (RF) filters have been used in aircraft testing using 2287.5 Mhz Multiple Access (MA) to mitigate this problem, but the associated insertion loss would be unacceptable for orbiting spacecraft design. The H-II Transfer Vehicle (HTV) mission has also designed a 2287.5 Mhz filter, but the associated insertion loss is high and testing with TDRSS is not scheduled until next year, so overall performance of that filter is undefined at this point. Operational workaround agreements are in place to protect the DSN.

In addition, in 1995, International Telecommunications Union (ITU) Recommendation 1157 was established, defining protection criteria for the DSN missions, and establishing the levels which interfering signals cannot exceed. The current MA missions violate those levels; significant filtering is required to meet the protection requirements. Figure 1 illustrates the problem. It shows a typical MA omni antenna, 0 Dbw, 1 Kbps customer in low earth orbit, and the expected power spectral density when this customer is within 1 degree boresite of the DSN 70M antenna. Curve A (sin x/x curve) shows the 2287.5 Mhz spread signal vs. frequency, and clearly shows the distribution into the DSN band with essentially no filtering. Curve B shows the protection level required per ITU 1157 (at -222 dbw/Hz). Curve C shows the filtered MA signal after filtering is applied that meets the ITU

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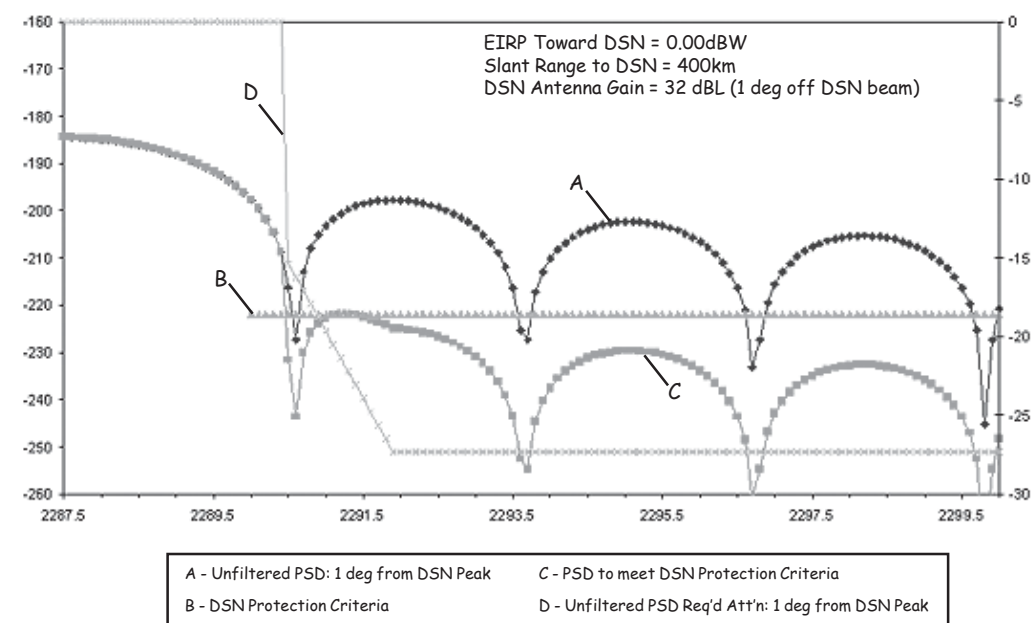


Figure 1: Attenuation required for 1 degree off-pointing angle

(continued from page 5)

1157 requirement. Curve D relates to the ordinate axis on the right, and indicates the amount of filtering required in db. It is important to note that this data pertains to a situation at 1 degree or greater of the DSN antenna boresite. For situations where the interfering mission is within the 1 degree cone of the DSN antenna, acceptable filtering will not be practical, and an operational workaround (e.g., shutoff) may be necessary, as determined by the DSN.

The typical DAS customer uses an omni antenna with five watts RF power and transmits one Kbps (Swift, GLAST). The problem then, is to design a filter that would significantly reduce the DAS energy above 2290 Mhz, while not significantly affecting the already small link margin. Engineers have studied candidate filter designs, and plan to test them soon to determine the best choice consistent with minimum acceptable insertion loss. Baseband digital filtering appears to offer the best characteristics when attenuation, insertion loss, and weight are considered. The test will use an engineering model transponder, and will include testing with TDRS. Once the best filter design is identified, that design will be made available to all transponder/transceiver designers intending to use the 2287.5 Mhz channel. The Space Network Users Guide (SNUG Rev 8) contains the relevant information, and all designers should ensure that this filtering is included in their transponder/transceiver specifications.

It is fully expected that this final filter design will not completely eliminate the problem, but will mitigate it significantly. Additional operational workaround arrangements may be required. Agreements with the DSN include the following:

1. All missions using 2287.5 Mhz will incorporate appropriate filtering in their design to meet the ITU Recommendation 1157

2. All missions using 2287.5 Mhz will supply JPL with accurate, current orbital elements
3. Using those elements, JPL will generate orbits, and merge them with the DSN schedule to determine when possible conflicts might occur with critical DSN events
4. JPL will contact the SN schedulers, and request that the interfering mission cease transmissions during the specific time it is expected to be within 1 degree of the antenna boresite of the DSN site involved with critical operations

For some missions like Swift (which is in a low inclination orbit) the probability of interference is so small that it essentially will be a non-problem. For other missions such as GLAST (28 degree inclination) and GPM (65 degree inclination) that will spend significant time flying over the DSN sites, operational workarounds will have to be performed during periods where conflicts are predicted. These situations are expected to be rare, and planning will be done to minimize adverse interference.

What I have described so far is the technical side of this issue; the technical approach currently underway is primarily based on spectrum management considerations. MSP and DSN managers intend to discuss this issue further, to ensure minimal impacts to DAS customers and the DSN customers. Based on the results of these meetings, some of the above strategy may be altered. It is expected that the filter test results will be available in the next few months, and the management team meetings are scheduled for the July/August time frame. Look for an update in the next issue of *The Integrator*.

By Frank Stocklin GSFC Code 451

For additional information on this topic, please contact the author via email (Frank.Stocklin@gsfc.nasa.gov) or telephone (301-286-6339).

MSP Restructuring Update

The restructuring of the Mission Services Program (MSP), described in the March 2002 issue of *The Integrator*, is still in the works. The restructuring plan was accepted by Code 400, and has been submitted to the Office of Human Resources. Also, NASA Headquarters is currently in the final stages of agreeing to a Memorandum of Agreement (MOA) between the Enterprises regarding the management of NASA's Space Communications Networks. This MOA will identify the roles and responsibilities of the Enterprises, and provide the management principles they will follow to ensure the Networks are managed for the benefit of all of NASA.

We anticipate that by the next issue of *The Integrator*, both the restructuring of MSP and the MOA will be signed.

By Kevin Mc Carthy/GSFC Code 450

For additional information on this topic, please contact the author via email (Kevin.P.McCarthy.1@gsfc.nasa.gov) or telephone (301-286-9516).

Mission Services Program Invests in the Future

The Program is proud of the Mission Services employees who continue their Outreach activities, sharing the excitement of NASA.

Program Outreach initiatives have been varied. Program Manager Phil Liebrecht has given stimulating talks to classes at Paint Branch High School and Takoma Park Middle School, while Roger Flaherty spoke to the Concordia Astronomy Club in Monroe Township, NJ. The Customer Commitment Office's Larry Phillips has been reaching out creatively. He spoke to Oxen Hill High School Science and Technology students and the NASA Headquarters Washington Math Science Technology Public Charter High School, judged an African American Inventors Contest, and participated in the Partnership Award for the Integration of Research into Undergraduate Education Tour. Larry also contributed to the Baltimore Basketball Academy SAT tutorial discussions.

The Space Network Project's Flight Dynamics Facility employees conducted five tours at the request of the Public Affairs Office. The tour groups varied: student groups were from Covenant Life Elementary School in Gaithersburg, MD, and Central Virginia Community College Electronics Technology Department in Lynchburg, MD; other groups included the Women's Speed Skating Olympic Gold Medallist, the Men's Doubles Luge Olympic Silver Medallist, and a Korean Military Delegation. Not to be outdone, the TDRS Project provided speakers to a Bowie fifth grade class, four classes at Hyattsville Elementary School, and provided the TDRS-I Guest Operations Briefing during the Kennedy Space Center TDRS launch activity. The TDRS Project also supported a High School team at the National Championship tournament for High School Robotics in Orlando, FL, as well as other Practical Robotics activities in California and Washington, D.C. (see the article on TDRS Project outreach activities on page 25 for more details).

This Spring, Emeritus employees Bob Stanley and Hugh O'Donnell have been busy judging Science Fairs at Beltsville Academic Center, St. Joseph's Academy, Laurel's Deerfield Run Elementary, Calverton Elementary School, and an area Science Fair at Prince George's Community College in Largo, MD. Bob and Hugh also rolled up their sleeves to assist Calverton Elementary School in filing its application for an Amateur Radio on the International Space Station; helped members of the DuVal High School Teacher Assistance Program apply for excess GSFC

computers to be used for a computer repair and technology class; and finally, drew up plans for mentoring two summer students from the National Space Club.

It takes time, dedication and commitment to share so many talents in very different ways. Well done!

By Rosemary Bruner/GSFC Code 450

For additional information on these and other outreach opportunities, please contact the author via telephone (301-286-2648) or email (Rosemary.V.Bruner@gsfc.nasa.gov).

Success Is Based on Safety

Safety continues to be an important focus for the Mission Services Program. Program Manager Phil Liebrecht holds quarterly meetings with Mission Services Safety Managers and their Project Managers to reinforce our 'safe thinking' approach to workplace activity. Program Safety Managers are doing their part to ensure safe environments too, by developing monthly safety presentations and briefings for their projects, and performing quarterly safety inspections of their work areas.



The breadth of monthly briefing topics is impressive. We have taken a look at our environment, including threats from asbestos and carbon monoxide, poison control, and fire evacuation procedures. Safe equipment handling has been emphasized this spring, including driving in wintery weather, operating lawn mowers and garden equipment, and using grills and barbecues safely. Finally, briefings creatively addressed other areas of general safety interest, including summertime safety, making healthy resolutions, avoiding and treating jelly fish stings, beach safety, symptoms of hypertension, and being street smart.

All of these activities are designed to remind us that safety is an important element in all that we do. We have a right to a safe workplace, and the responsibility to continue to do our part to make it that way. Think Safety!

By Rosemary Bruner/GSFC Code 450

For additional information on safety, please contact the author via telephone (301-286-2648) or email (Rosemary.V.Bruner@gsfc.nasa.gov).





"MSPO is very interested in obtaining customer feedback and gaining insight concerning present and future networking plans and needs."

Customer Commitment Office

Mission Services Customer Forum Convenes

There is an old saying that goes something like this: "99% of problems are due to poor communications." As is the case for most large, complex organizations, this old adage is relevant to the MSP. For our operations to proceed optimally, it is crucial that we maintain effective contact among personnel from the Ground Network (GN), Space Network (SN), and the flight projects, as well as among the flight projects, themselves.

Maintaining customer satisfaction is a goal of the MSP Office (MSPO). One step on the road to achieving that goal is to listening to what customers have to say. Toward that end, the MSPO instituted the Mission Services Customer Forum (MSCF) last November. The forum provides an opportunity for customers and service providers to raise issues or concerns in an open environment.

Since its inception, the MSCF has been held three times, most recently in May. During these meetings, participants have discussed issues such as the retirement of 4800-bit block encapsulation, transition to the

longitude-based TDRS names for scheduling, and the lack of a GSFC-JPL Memorandum of Agreement (MOA).

Presentations at the May forum highlighted the customer commitment process and spectrum management. The former served to familiarize new customers with how services are obtained from Code 450. The spectrum management presentation provided insight regarding what is involved when new customers need a frequency for their spacecraft. The intent behind both presentations was to provide customers with background knowledge to aid in mission development and securing Code 450 services.

MSPO is very interested in obtaining customer feedback and gaining insight concerning present and future networking plans and needs. The interaction at the MSCF aids both the effectiveness and efficiency of network planning, operations, and support. Teamwork among the flight projects improves as well.

All projects are strongly encouraged to provide representation to the Forum. We believe the MSCF is a very useful tool for customers, operations, and advanced planning personnel. MSPO continues to encourage attendance by new customers as well as representatives from new missions. Participation in the MSCF will probably most benefit project representatives involved with ground system design and integration, as well as Mission Commitment Managers, Customer Service Representatives, and other service providers. Others representatives, especially from projects and programs, are welcome.

The MSCF is held quarterly. Future meetings (August 22 and November 21) will be held in the Building 8 auditorium at GSFC. Participants may attend in person or by telecon. Webcasts may be available for future meetings. Meeting-related materials (such as the agenda and presentations) are available on the Web at <http://npas19.honeywell-tsi.com/mscf>.

By Eric Mathis/CSOC/HTSI

For additional information about the Mission Services Customer Forum or to suggest/request a presentation on a relevant subject, contact Al Levine at 301-286-9436 or at Allen.J.Levine.1@gsfc.nasa.gov, or visit the website (<http://npas19.honeywell-tsi.com/mscf>).

Space Network Online Information Center Includes New Information

Ever wonder how NASA's satellite communication network evolved from just a few remotely located ground stations to the worldwide Space Network (SN) we utilize today? Find the answers in the presentation just added to the SN Online Information Center. Track the evolution of satellite communications from the early days of the Minitrack, through the initial testing of the space based relay concepts with ATS-6. Curious about what the future holds for satellite communications? You'll find that here as well! Link directly to the presentation at <http://msp.gsfc.nasa.gov/tdrss/satcom.PDF>.

The SN Online Information Center continues to develop information modules on numerous subjects in addition to the Tracking and Data Relay Satellite System. You'll still find authoritative information about TDRSS, but we've now included information and links to other Mission Services Program and Space Network activities.

So, as always, if you have questions about the SN, check out the SN Online Information Center. We are continually updating and improving the site. Recent improvements and additions include links to the Communications Link Analysis System website that provides refined forward and return service link budget calculators. These calculators will allow you to determine if the SN is a viable solution for your communications requirements.

We have updated the information module containing recent SN overview presentations. Updated TDRS constellation information is also included, and the SN Online Information Center provides links to the SN User's Guide. If you have a specific question, send it to us via email, using our feedback form. We'll direct your question to the appropriate expert, and return an answer directly to you via email. As always, the calendar listing upcoming launches and other activities of interest is updated monthly. The entire site is updated twice monthly to ensure information is current and accurate.

The website can be found at <http://msp.gsfc.nasa.gov/tdrss/>. Detailed information is currently available on:

- The Tracking and Data Relay Satellites (including TDRS H, I, J)
- Demand Access System
- The White Sands Complex including WDISC
- Guam Remote Ground Terminal
- McMurdo TDRSS Relay Terminal System
- TDRSS Telecommunication Services
- Customer Communication Systems and Products (including Transponders)
- TDRSS Applications
- Plus much more...

By Jeff Glass/FHA

Latest Hubble Servicing Mission a Resounding Success!

Last March, the Space Shuttle embarked upon Hubble Servicing Mission 3B (SM3B). On this very successful mission, Shuttle astronauts performed a number of planned upgrades, replacements, and installations to the Hubble Space Telescope (HST) during five scheduled "spacewalks." They installed a new instrument—the Advanced Camera for Surveys (ACS)—that can view light in wavelengths ranging from the visible to the far ultraviolet. ACS has ten times the discovery power of the instrument it replaces, meaning it can produce ten times the data in the same amount of time. Astronauts replaced a failed Reaction Wheel Assembly (RWA), which is part of the HST's pointing system, and also removed the solar arrays put on during Servicing Mission 1, replacing them with smaller, more powerful arrays.



SM3B astronauts installed new rigid solar arrays on HST

Perhaps the biggest accomplishment of SM3B was the installation of a new HST Power Control Unit (PCU). The PCU is the system that controls and distributes the power generated by the solar arrays and battery to the circuitry that charges all of the HST's instruments. To install the new PCU, controllers had to completely shut down all of HST's systems. It was the first time HST had been turned off since launch! Observers held their breaths as the controllers powered HST up again, after the astronauts completed the PCU installation. HST performed beautifully, with all systems booting up optimally! With the new PCU and solar arrays, the HST's electrical systems can be considered "brand new."

Astronauts also retrofit HST's Near Infrared Camera and Multi-Object Spectrometer (NICMOS) with the NICMOS Cryocooler (NCC). NICMOS (installed during SM2) has been dormant since 1999, when it was discovered that its cooling system was not

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functioning adequately. The new cooling system is functioning well and has restored NICMOS to life, enabling HST to provide the scientific community with phenomenal space-based infrared observations once again.

SM3B achieved a 100% success rate despite some difficult situations encountered during the mission. Immediately after launch, one of the Shuttle's cooling systems began to leak, leaving only the backup system functioning properly. These cooling systems are vital to the mission because they enable the onboard oxygen generators that provide the crew with air to breathe. Eventually, the malfunctioning system was stabilized, and mission directors determined that mission risk was low enough to proceed as planned.

Additionally, before one of the scheduled Extra Vehicular Activities (EVAs), one of the astronauts had a problem with his spacesuit—it began to fill up with water after he put it on! He had to evacuate the space suit, and result, causing a delay in that day's activities. EVA activities are closely scripted, so even a slight delay has the potential to disrupt the entire schedule. The astronauts, however, still managed to complete all of the scheduled events that day, despite the delay.

Now that SM3B is complete, the HST team is looking forward to the next servicing mission, SM4, scheduled for March 2004. During SM4, two new instruments—the Wide Field Camera Three (WFC3) and the Cosmic Origins Spectrograph (COS)—will be installed, and additional maintenance performed.

HST engineers are beginning to prepare the initial command plans and scripts for SM4. Every event and action of each servicing mission must be scripted completely to ensure that such a complex undertaking proceeds effectively. For example, a servicing mission script even specifies the number of turns an astronaut must make to unscrew a bolt. Physical actions "feel" very different in space than on Earth, and to prevent any mistakes, astronauts follow the mission script exactly.

The HST team is also developing the time sequence of SM4 events. They must calculate in advance the duration of each servicing mission activity, so they can efficiently plan EVAs. They are developing procedures for tests to make sure that the ground system equipment (hardware and software) will function properly during SM4. Current plans call for ground system testing to commence in October 2002, simulations testing with astronauts to start in March 2003, and joint simulations with Johnson Space Center resources to begin in June 2003.

In addition, HST is being considered as a potential subject for the season premiere of the television show, "60 Minutes." Ed Bradley and a team from the show have visited the HST control center at GSFC on a number of occasions to gather data, so stay tuned....

*Information from
David Campbell/
GSFC Code 581*

*For more information
about the Hubble
Space Telescope and
its servicing missions,
visit the GSFC HST
web site at [http://
hubble.gsfc.nasa.gov/](http://hubble.gsfc.nasa.gov/)*



This image, taken by ACS (installed during SM3B), shows two nearly identical colliding spiral galaxies. The galaxies are nicknamed "The Mice" because of the long "tails" of stars and gas they emanate.

Aqua Spacecraft Now In Action

NASA successfully launched the Aqua spacecraft from the Vandenberg Air Force Base on 4 May 2002 at 0955z on a Delta II expendable launch vehicle. The launch and ascent phase proceeded nominally. At Delta payload fairing separation, Aqua acquired TDRSS immediately, and maintained communications as scheduled throughout the power flight regime to orbital insertion. The Aqua spacecraft was rolling along with the launch vehicle, presenting a challenge during the initial acquisition. In anticipation of this situation, additional Space Network (SN) resources had been scheduled to ensure contact was made during this critical period. The Aqua separation vector sent from the Delta launch vehicle (captured by a P-3 chase plane and relayed through another TDRSS link) indicated that the launch trajectory was nearly perfect. By design, Aqua's initial orbit was lower than its 705 Km operational orbit, and Aqua spent the next few weeks executing orbit raising maneuvers to achieve operational orbit. Aqua achieved operational orbit with a final maneuver on June 18, and instrument activation and checkout are continuing successfully.

According to the Aqua web site (<http://aqua.nasa.gov/science.html>), "Aqua, the latest in the Earth Observing System (EOS) series of spacecraft, will focus on the multi-disciplinary study of Earth's interrelated processes

(atmosphere, oceans, and land surface) and their relationship to changes in the Earth system. The global change research emphasized with the Aqua instrument data sets includes atmospheric temperature and humidity profiles, clouds, precipitation and radiative balance, terrestrial snow and sea ice, sea surface temperature and ocean productivity, soil moisture, and the improvement of numerical weather prediction. During its five-year mission, Aqua will also make critical contributions to the monitoring of terrestrial and marine ecosystem dynamics.”

Data from Aqua will enable scientists to more accurately monitor climate trends—knowledge which has the potential to positively affect the lives of humans all over the world.

No mission, however, proceeds without some unexpected events, and Aqua is no exception. On May 19, Aqua placed itself in safe hold, when its on-board systems detected a fault condition in the electrical power management subsystem. Upon detection of this condition, the spacecraft initiated an orderly transition to survival mode of all its instruments, and maneuvered itself to Sun Hold mode to keep power on the solar panels. At that time, Aqua exercised the “911 service” created to provide a Demand Access-like service in time for Aqua launch, changing telemetry data rates to the Multiple Access mode, and sending a distress call back to the Flight Operations Team. With this custom service,

the ground controllers were able to receive spacecraft telemetry immediately and confirm the state of the emergency, which greatly aided in the replanning for the continuation of the mission. The problem with the electrical power management subsystem has now been resolved, and the Aqua mission is proceeding as planned.

Lockheed Martin is operating Aqua from within the Earth Observing System Operations Center (EOC) in Building 32 at Goddard. This work is not part of the Consolidated Space Operations Contract (CSOC) contract, but may be transitioned to CSOC after the next EOS mission (Aura) is safely in orbit some time in 2004.

To provide on-board clock correlation, Space Network contacts are required every day for the life of the Aqua mission. In addition, the Ground Network polar ground stations will collect data once every orbit, an activity that began May 10. Flight Dynamics will provide the TDRSS locations for Aqua, and the NASA Integrated Services Network (NISN) operates the data lines that transport spacecraft data back to Goddard. The Earth Observing System Data Operations System (EDOS) captures the data at Goddard, and provides preprocessing and initial distribution for over 300 gigabytes of data every day.

Aqua science operations are expected to begin in late July, towards the end of the activation and checkout period. All instruments have been turned on and are functioning. Until recently, there was some concern with the Advanced Microwave Scanning Radiometer-EOS (AMSR-E) instrument. Data from the instrument was somehow being interrupted, leaving large gaps in the data received on the ground. This situation has ended, and the instrument team is currently investigating possible causes for this anomaly.

Aqua promises to yield a wealth of data for the scientific community to analyze, increasing our knowledge of our Earth’s global processes. Watch future issues of *The Integrator* for updates on this exciting mission.

By Dennis Mateik/HTSI

For further information on Aqua, visit the Aqua website at <http://Aqua.nasa.gov/> or contact the author via email (Dennis.Mateik@honeywell-tsi.com) or telephone (301-805-3297).

Aqua Specifications	
Weight	6784 lbs
Size Stowed	8.8 ft. (2.68m) x 8.2 ft. (2.49m) x 21.3 ft. (6.49m)
Size Deployed	15.8 ft. (4.81m) x 54.8 ft. (16.7m) x 26.4 ft. (8.04m)
Power Requirements	4.6 kilowatts generated by the solar array.



On May 4, 2002, Aqua launched from Vandenberg AFB on a Delta II ELV.

Expendable Launch Vehicle News

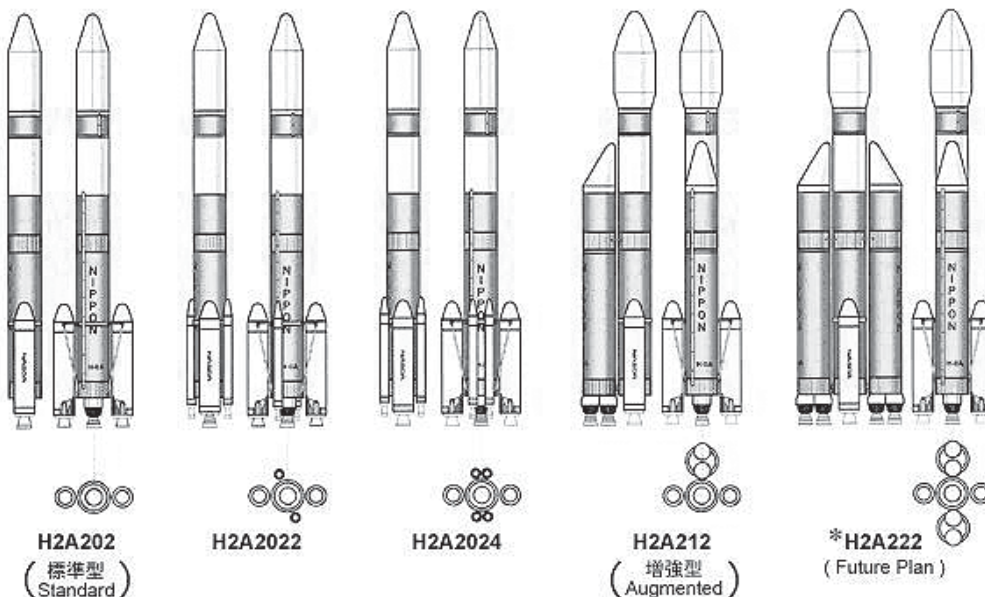
ELV launch activity slowed during the past three months, with only two significant launches taking place since the launch of TDRS-I on March 8th. Delta-II placed Aqua (EOS-PM) in orbit on May 4th, followed by the launch of Sea Launch/Galaxy 3C on June 16th. This was the first Sea Launch mission in over a year. Liftoff occurred at 6:39 PM EDT from an ocean-going launch platform stationed on the equator at 154 degrees west longitude. Galaxy 3C was placed in a transfer orbit with an apogee of 25,769 miles.

Launch activity is due to increase during the coming months, with inaugural flights scheduled for both Atlas-V and Delta-IV. With the introduction of these two new launchers, competition for launch services will increase, and added pressure will be placed on Arianespace and their Ariane-V launcher. While these effects will not be felt immediately, contracts 3 years and out will become very important, and could affect survival of some launchers.

The Japanese Space Agency (NASDA) continues to develop its H-IIA launcher, and plans to use the Space Network (SN) in future years. As with Atlas-V and Delta-IV, the H-IIA has several different configurations and support capabilities. The following chart shows the various configurations available in the H-IIA series.



Sea Launch Zenit 3SL Rocket Liftoff

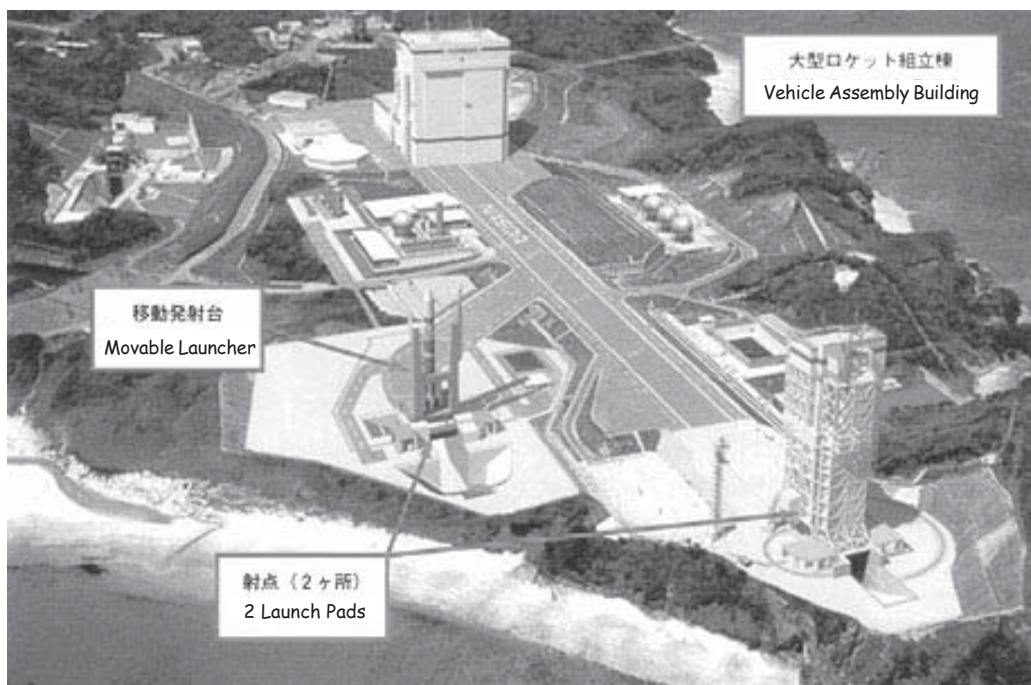


* H2A222は将来の発展計画です。

H-IIA Launch Vehicle Family

The H-IIA vehicle is launched from the Yoshinobu Launch Complex at Tanegashima Space Center in Japan. There are two launch pads at the launch complex that is collocated with the Vehicle Assembly Building. Launch vehicles are transported to the launch pad using a movable launcher platform very similar to the one used for the Space Shuttle.

NASDA personnel visited Goddard on March 25th and participated in the fourth Technical Interchange Meeting (TIM) between H-IIA and SN personnel. The Goddard Visitors Center was used for the first time for this meeting and provided a unique location for our TIM.



Yoshinobu Launch Complex

A Technical Interchange Meeting between French Space Agency (CNES) Ariane 5 representatives and NASA SN representatives was held at Goddard Corporate Park on June 11th, and participants discussed the future use of the SN for Ariane-V/ATV launches. CNES reports that program schedules are under review along with cost studies, and that initial use of the SN to support Ariane-V launches may be pushed back. Additional information should be made available in the coming months.

By Joe St. John/Lockheed Martin

For further information, please contact the author via telephone (301-805-3044) or email (joseph.stjohn@csconline.com)

Upcoming ELV missions (dates subject to change)	
JUN 24	Titan-II/NOAA-M from Cape Canaveral, FL
JUN	Ariane-V/Stellat 5 & N-STAR c from Kourou, French Guiana
JUL 1	Delta-II/Contour from Cape Canaveral, FL
JUL 29	Atlas-V/Hot Bird 6 from Cape Canaveral, FL (This will be the inaugural flight for Atlas-V)
AUG	NASDA H-IIA/DRTS from Tanegashima, Japan
AUG 6	Titan-IV-B/NRO from Cape Canaveral, FL
AUG 11	Delta-II/GPS-2R-8 from Cape Canaveral, FL
AUG 14	Pegasus XL/GALEX from offshore east coast of FL
MID YR	Atlas-III/AsiaSat 4 from Cape Canaveral, FL
AUG 31	Delta-IV/W5 from Cape Canaveral, FL (This will be the inaugural flight for Delta-IV)
3 RD QTR	Sea Launch/Telstar 9 from the equator, 154 deg west longitude

Tropical Rainfall Measuring Mission: Summer 2002 Status

Tropical Rainfall Measuring Mission (TRMM) mission operations continue to be nominal, with no anomalous conditions to report. It has been officially determined that we have reached the anticipated 'Blow Down' mode of operation for the Reaction Control Subsystem (RCS). The amount of pressurant, which is required during Delta-V maneuvering, has been reduced to the extent that the engineering staff cannot regulate these activities as precisely as before. The flight Operations Team (FOT) has observed a slight drop in proficiency, although our Delta-V efforts remain safe and problem-free.

On a positive note, solar flux conditions appear to be lessening. Time between Delta-V maneuvers has lengthened to about six days, since the beginning of May. This fact is encouraging, since we remain committed to a controlled reentry effort when the TRMM fuel level reaches 157 Kg. We are still guardedly optimistic that solar flux incidents and their severity will continue to abate.

The TRMM engineering group, working with our Mission Director, recently conducted a feathering test of the spacecraft solar arrays.

(continued on page 14)

(continued from page 13)

This initial test was done during the week of 27 May as a means to reduce drag to further lengthen the time between maneuvers. Additional testing will be conducted and results analyzed before a decision to implement feathering is approved.

Please check the official TRMM web site for examples of instrument data sets and related information. It can be viewed at <http://trmm.gsfc.nasa.gov>.

By Lou Kurzmiller/TRMM
FOT

For additional information regarding TRMM, please contact the author (lkurzmil@pop500.gsfc.nasa.gov) or Vickie Moran/TRMM Mission Director (vickie.e.moran.1@gsfc.nasa.gov).

TOPEX/Poseidon Technology: Unbelievable, But True!

The U.S.-French TOPEX/Poseidon (T/P) satellite continues to function exceptionally well as the Project approaches the end of its tenth year in space. Attention is now focusing on Jason-1, the follow-on mission to TOPEX/Poseidon. Aside from its longevity and data delivery rate (>99%), the accomplishment of T/P is only made possible through technology that is beyond what most people can comprehend, or even believe.

Orbiting at an altitude of 1336 kilometers (~830 miles) above the Earth, it is possible for the T/P instruments to measure sea-level height to an accuracy of 4-5 centimeters (or about two inches!). To achieve these measurements, the satellite position in space must first be precisely determined. Through a worldwide network of ground-based laser tracking stations, laser beams are periodically reflected off a mirrored reflector array on the satellite. Ranging data from the laser stations are combined with information from two precise range and Doppler receivers (the French "DORIS" and the U.S. "GPS" instruments) on board the satellite. Using this combination of data, the satellite position can be calibrated to an accuracy of 2-3 centimeters (~1 inch).

Radar altimeters on T/P make up the second component of ocean height measurement from space. Microwave pulses from a radar dish on the satellite are directed towards the ocean surface, and reflect back to the dish. In conjunction with corrections for columnar water vapor and the Earth's oblateness, these radar range measurements are accurate to 3-4 centimeters. By combining and subtracting this data with the orbit position, scientists can derive ocean height to a 4-5 centimeter overall accuracy.

To independently verify this derived accuracy, two verification sites are maintained by the Project—one is located on the island of Corsica in the Mediterranean sea, and the other is resident on an oil platform off the coast of California. Separate range and Doppler systems at the sites are combined

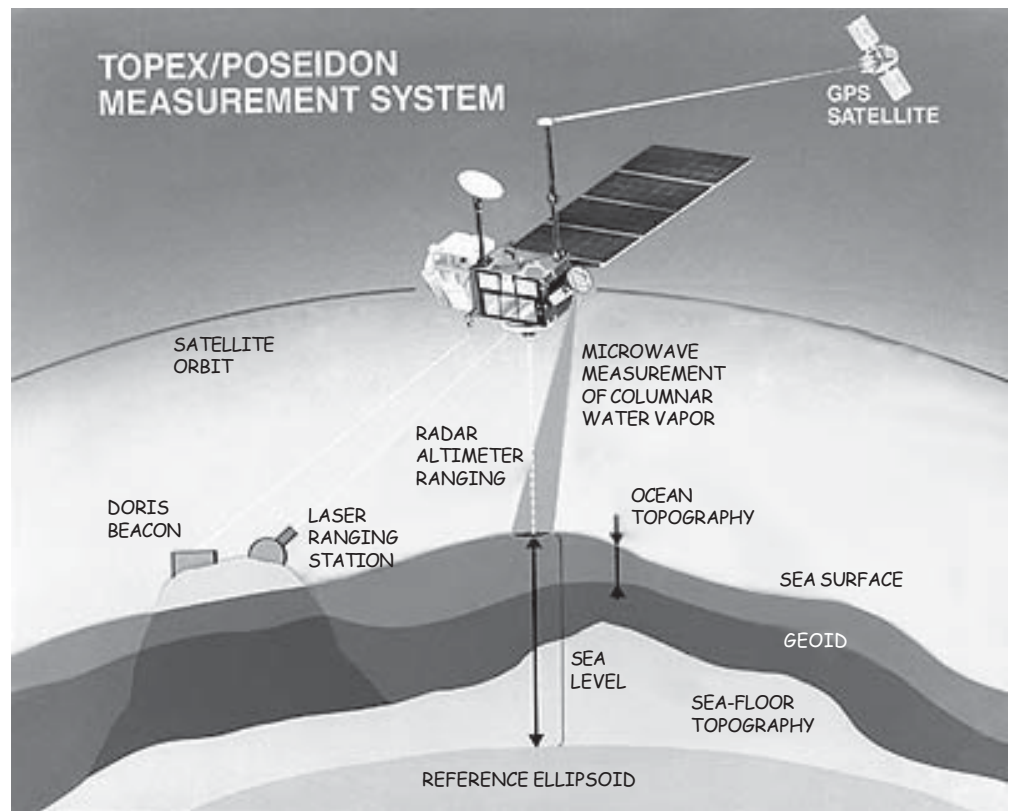


Diagram showing how several measurement and calibration components work together to produce the highly precise and accurate T/P measurements. Sea level is determined by differencing the satellite's position above the Earth's reference ellipsoid from the calibrated ocean height as determined by the radar altimeter.

with local measurements of water levels from tide gauges, and these data are then correlated and compared with T/P information. In this way, ongoing instrument performance can be validated and monitored to detect any errors in orbit or sea height measurements on a regular basis.

Although valuable data from the aging T/P satellite continues to be gathered, efforts of the flight team here at the JPL Earth Science Mission Center (where we also monitor the TOPEX/Poseidon, ACRIMSAT, and QuikSCAT satellites) are currently focusing on the newly launched Jason-1 satellite. Throughout the Jason-1 launch and early orbit phases, all systems and instruments have functioned as expected. The T/P and Jason-1 Project personnel are optimistic that both missions will continue to uncover new scientific phenomena even more significant and exciting than those already achieved.

*By Mark Fujishin/Manager,
JPL Earth Science Mission
Operations*

*For additional information
on TOPEX/Poseidon or
Jason-1, please contact the
author via telephone (818-
393-0573) or email
(Mark.D.Fujishin@jpl.nasa.gov).*

RHESSI: The Spacecraft That Could

Dubbed "Mission Possible," the High Energy Solar Spectroscopic Imager (HESSI) was successfully launched into a low earth orbit at 12:26 p.m. PST on February 5, 2002. The launch occurred from Cape Canaveral Air Force Station, Fla. with the spacecraft tucked inside a Pegasus XL rocket. Within months of its launch, HESSI's name was changed to "Ramaty High Energy Solar Spectroscopic Imager" in honor of Reuven Ramaty, who was so instrumental to the Aqua program, but who passed away before the launch of the spacecraft.

RHESSI encountered a rough road on the way to the launch pad. In March 2000, the spacecraft was over-vibrated in the sine-burst test (20 Gs applied instead of 2Gs for 200 milliseconds). The spacecraft was carefully inspected, and was found to be in good shape, except for two damaged solar arrays, a broken imager support ring, and one strained gable. Engineers installed new and improved solar arrays and a new deck, completed and aligned a refurbished bus structure, and fully retested the spacecraft and instrument in time for launch by January 2001. RHESSI was sent to Vanderbilt Air Force Base (VAFB) for functional and operations testing, then mated to the Pegasus XL rocket in May of 2001. While waiting for the launch authorization, there was a mishap with the X-43A test flight that caused it to fail. This delayed the launch of RHESSI until a complete investigation was performed. The "go ahead" was given in December 2001 and prelaunch preparations began again at Cape Canaveral.



Personnel at The Paul Scherrer Institute in Switzerland preparing the RHESSI telescope tube for the Imaging Telescope Assembly, which consists of the telescope tube, grid trays, Solar Aspect System (SAS), and Roll Angle System (RAS).

Since the launch, RHESSI has completed instrumentation checkout and started science operations. RHESSI is on a dedicated free-flying satellite whose defined payload is a single instrument, an X-ray and gamma-ray imaging spectrometer. Robert Lin of the University of California, Berkeley is the principal investigator. RHESSI is set to explore the basic physics of particle acceleration and energy release in solar flares. RHESSI will work to determine the frequency, location, and evolution of impulsive energy release in the Sun's corona; study the acceleration of electrons, protons, and heavier ions in flares; study the heating of plasma to tens of millions of degrees and determine its relationship to particle acceleration; study the propagation and evolution of energetic particles in flares; and determine the relative abundances of accelerated and ambient ions in flares.

In addition to the sun, RHESSI will obtain images and spectra of the Crab Nebula with 2 arcsecond spatial resolution and ~1 keV spectral resolution.

The spacecraft is performing beyond expectations and we are looking forward to a long list of observation successes to come from RHESSI.

By Maureen Madden/GSFC Code 581

For additional information on RHESSI, contact the author via telephone (301-286-8231) or email (mo.madden@gsfc.nasa.gov).

RHESSI Mission Vital Statistics

Weight:	645 lbs.
Power:	414 Watts
Size:	85 in tall, 43.3 in wide before solar panel deployment
Mission Life Goal:	2-3 years
Orbit:	Circular
Altitude:	600 Km
Inclination:	38 Degrees



Science Payload:	X-ray and gamma-ray imaging spectrometer
Energy Range:	3 keV to 15 MeV
Angular Resolution:	2 arcseconds to 100 keV 7 arcseconds to 400 keV 36 arcseconds to 15 MeV
Temporal Resolution:	Tens of ms for basic image 2s for detailed image
Field of View:	Full Sun
Number of Flares:	~1000 imaged to >100 keV. ~100 with spectroscopy to ~10 MeV



CODE 452

Space Network Project

TDRS-8 Transitioned to Operations

NASA accepted TDRS-8 (formerly known as TDRS-H) from Boeing Satellite Systems in October 2001. In addition to offering the same service capabilities as the first-generation TDRS (S-Band Single Access, Ku-Band Single Access, and Multiple Access) the second-generation TDRS offer a Ka-Band Single Access service and enhanced S-Band Multiple Access capabilities.

After NASA accepted TDRS-8 from Boeing Satellite Systems, engineers formulated a plan for putting the new satellite into Space Network (SN) operations. It was decided initially to collocate TDRS-8 (in storage mode) with TDRS-7 (supporting SN customer operations) at the 171 degree West location. Operations would be transferred from TDRS-7 to TDRS-8 at the earliest date feasible, considering customer activities and constraints. TDRS-7 would then be configured to storage mode, and remain collocated with TDRS-8 in the 171 degrees West location.

NASA selected April 23, 2002 as the date for making TDRS-8 operational in the 171 degrees West location. SN personnel designed a transition plan to minimize customer impacts, especially downtime for TDRS operations in the 171 degrees location. Network Advisory Messages informed the SN customer community of the plans so that they could make any necessary preparations. To implement the transition, SN operators performed the required TDRS/Space to Ground Link Terminal (SGLT) hand-overs, Network Control Center Data System (NCCDS) database changes, and payload reconfigurations for TDRS-7 and TDRS-8. The transition was successfully completed without any customer data loss!

Since the transition of TDRS-8 into SN operations on April 23, customer support with the new TDRS has been very successful.

By Bryan Gioannini/GSFC Code 453

For additional information about TDRS-8 or the White Sands Complex, please contact the author via email (bryan.gioannini@gsfc.nasa.gov) or telephone (505 527-7002).



Artist's rendering of the
TDRS-8 spacecraft

Network Control Center News

The Network Control Center (NCC) has significant operational accomplishments and several ongoing Data Services Management Center (DSMC) related activities to report in this issue of *The Integrator*.

Since January 2002, the NCC has supported eight Expendable Launch Vehicle (ELV) launches and three Space Shuttle missions.

The DSMC transition for the Space Network (SN) occurred on June 25. All SN Scheduling operations are now performed at the DSMC at the White Sands Complex (WSC) in New Mexico. In preparation for the transition, the DSMC assumed the prime role on each shift, utilizing remote terminals and a phased approach. DSMC scheduler training began on site in the NCC at GSFC for a three-week period for each DSMC scheduler, and continued with additional training via remote terminals at the DSMC. The NCC Lead Scheduler and one NCC Technical Manager traveled to the DSMC to provide additional training and assist through the transition.

The NCC Operations Evaluation Team (OET) and NCC Software Sustaining Engineering team also provided DSMC on-site support during the transition. NCC Software Sustaining Engineering will continue to provide ongoing emergency

response and sustaining engineering post transition. Even though the DSMC is now the prime scheduling facility, the NCC will remain as the Auxiliary Network Control Center (ANCC) until an ANCC can be assembled at the White Sands Complex.

The NCC remained fully staffed on all shifts and ready to support for two weeks after the DSMC system transition, and NCC staff were available to provide any required assistance via remote terminal and/or voice conversation.

NCC engineering personnel continue to support the DSMC transition by disassembling, packing, and shipping additional equipment that is scheduled for relocation to the DSMC. This effort includes the relocation of the current ANCC resources and the remaining NCCDS equipment.

Recently, NCC personnel brought the interim solution for automatic scheduling of the White Sands Complex (WSC) Transmission Control Protocol (TCP)/Internet Protocol (IP) Data Interface Service Capability (WDISC) online for a four-day period for proof of concept testing. WDISC enables customers at Mission Operation Centers (MOCs) to receive telemetry data and send commands using TCP/IP protocol via the Closed IP Operational Network (IONet). Currently, scheduling for WDISC is a labor-intensive effort. The interim automated scheduler provides a temporary solution that is available to the DSMC, should it be required prior to the permanent solution being implemented in the NCC Data System.

The NCC team also continues working to replace the ESI/SDS-1 phone system with the Nascom Voice Distribution System (VDS) system. The ESI/SDS-1 phone system is no longer supported by the vendor, and spare parts are limited.

By Joe Snyder/ATSC

For additional information, please contact Bill Webb/GSFC via email (bill.webb@gsfc.nasa.gov) or telephone (301-286-3264).

FDF Instrumental to EOS Aqua Launch

The EOS Aqua satellite, built by TRW for NASA, was launched at 5:54:58 a.m. EDT (0954.58 GMT) May 4 aboard a Boeing Delta 2 rocket from Vandenberg AFB in California. Aqua, the second of NASA's series of three Earth Observing System spacecraft, is to observe Earth's oceans, atmosphere, land, ice flows, snow packs and vegetation over its six-year mission lifetime to study the causes for, and the scope of, global changes to the environment. The Consolidated Space Operations Contract's (CSOC) Flight

Dynamics Facility (FDF) at the Goddard Space Flight Center provided primary flight dynamics support for Aqua, including standard delta launch vehicle support through separation.

CSOC FDF will provide primary flight dynamics support for orbit determination (OD) throughout the Aqua mission, including real-time support for ascent and station-keeping maneuvers. FDF is building on its extensive OD support experience for low-earth missions such as EOS-Terra, while at the same time blazing new trails for that support. FDF is using the standard Goddard Trajectory Determination System (GTDS) software to meet the stringent definitive (i.e., after the fact) OD accuracy requirements imposed by the Aqua mission. FDF has consistently met Aqua's accuracy requirements well within the allotted timeframe.

FDF has responded promptly to special requests for orbit information from various segments of the NASA community. FDF instituted new procedures to generate and provide mean orbit-element data via the FDF Special Request Product Server to support network loading analyses being done by CSOC. FDF responded to two special requests from the Flight Dynamics System (FDS) team. First, FDF created a definitive long-ephemeris product that will be maintained routinely, so that the daily post ascent-maneuver definitive ephemerides contain merged pre- and post-maneuver data.

This product is sent to the FDS, which then passes the ephemeris data on to the science teams. Second, FDF began generating Two-Line Elements based on our daily OD and delivered them to the X-band direct broadcast program staff.

CSOC FDF uses Logicon's Real Time Orbit Determination (RTOD™) filter for routine orbit determination for a number of the operational satellites it supports; it will be used for Aqua support once Aqua achieves mission orbit. FDF decided to use the Aqua Launch and Early Orbit phase as a target of opportunity to determine how well the RTOD™ filter could perform in a Launch and Early Orbit environment. There was a question of how effective it would be immediately after spacecraft separation from the launch vehicle, and with the large orbital ascent maneuvers. FDF decided to investigate how quickly the filter could get a good Aqua OD solution from the a priori tip-off vector, and how well it could track through the ascent maneuvers.

FDF began processing two-way tracking data immediately after Aqua spacecraft separation. FDF analysts (with suggestions from Logicon) applied their expertise in the use of RTOD™ to open up tolerances on how RTOD accepted data and tracked the satellite. Because of that expertise, and the fact that Aqua was tracked continuously for the first several hours, RTOD™ was able to process the data and



FDF Launch and Early Orbit Team

calculate the Range Bias and drag coefficient parameters. These updated parameters were used to re-run the tracking data through the filter, and nominal tracking (that is, meeting Aqua's orbit requirements) was achieved before the end of the first day. This result was not anticipated; the expectation was that several days of data would be needed before the modeling could be refined in RTOD™ to the point where nominal tracking could be achieved.

FDF then used the RTOD™ filter to investigate its capability to handle the large ascent maneuvers. FDF analysts received maneuver modeling information from the Aqua FDS, and were able to make maneuver files for the filter. Due to a significant thruster underperformance in the first large maneuver, the maneuver modeling in RTOD™ did not match very well with the actual maneuver. Nevertheless, FDF analysts were able to adjust (i.e., open up) tolerances and track back to nominal within several hours. The subsequent maneuvers have been much closer to predictions, and the filter has tracked through them with very little adjustment to the tolerances.

This result is very encouraging for two reasons. First, it gives us great confidence that we can use this proven FDF OD filter to support other low-earth missions during the Launch and Early Orbit phase. Second, it leads us to believe that when the maneuvers become smaller and better calibrated on-orbit, we should be able to model them in the filter ahead of time and have the filter "ride out" the maneuvers without assistance. This ability will be very helpful in supporting missions such as TRMM, that require frequent maneuvering to maintain orbital constraints.

By Dave Brown/CSC

For additional information, please contact Tim Thompson/CSC via telephone (301-286-5314) or email (Timothy.W.Thompson.1@gsfc.nasa.gov).

FDF on the Move

CSOC's Flight Dynamics Facility (FDF) has been located in Goddard Space Flight Center's (GSFC's) Building 28 since the fall of 1993. Although Building 28 is a great location and has served FDF needs well, lack of backup power capability has been an ongoing concern. With the NCC vacating space in Building 13, and ready availability of backup power there, a plan has been devised to move FDF operations to Building 13. In addition, FDF is scoping out a limited functional backup facility to be located in Building 25 that would be capable of supporting the Health and Safety of orbiting spacecraft.

FDF supports numerous missions with either in-flight operations or pre-launch mission planning and preparation for operations. Existing projects supported by FDF (and therefore affected by this move) are as follows:

ACE	GOES	QuikTOMS	TITAN
Aqua	GRACE	SAMPEX	TOMS-EP
ATLAS	HESSI	Sealaunch	TOPEX
ATV/HTV	HST	SEISMICSTAR	TRACE
DELTA	ICESAT	SNOE	TRIANA
EO-1	ISS	SOHO	TRMM
EOS Chem (Aura)	Landsat	STS	UARS
ERBS	MAP	SWAS	VCL
FAST	NOAA-K/L	TDRS-I	WIND
FUSE	POLAR	TDRSS	WIRE
GEOTAIL	PROSEDS	Terra	XTE

The FDF offers expert service, flexibility, and experience in several areas. As a recognized leader and innovator in the field of flight dynamics, it is able to satisfy a wide range of flight dynamics requirements. Areas in which the FDF routinely provides flight dynamics support to the above missions include the following:

- Attitude Determination, Prediction, and Control
- Expendable Launch Vehicle (ELV) and Shuttle Launch Trajectory Support
- Mission Design, Analysis, and Orbit Maneuvers
- Orbit Determination and Contact Acquisition Aids
- Tracking Station, Network, and Data Evaluation

A total of approximately 17,000 sq. ft of space will be required for the FDF facility. Of that, a little over 10,000 sq. ft will be in Building 13 with the remainder in Building 25. All the primary operations facilities and most of the operations staff offices will be housed in Building 13. Not only will this arrangement ensure the benefit of available backup power, it will also provide additional opportunities for FDF personnel to interact with Flight Operations Teams, since many of the control centers for missions in the preceding list are located next door in Building 3/14. Building 25 will be the site of a small backup facility with just enough equipment to ensure mission survival and office space for some support staff.

The FDF Move Team's strategy will be accomplished in three phases:

Phase 1: Construction/Configuration/Connectivity in Building 13/Move redundant hardware
FDF will order new hardware/software, install FDF legacy software, and perform a set of progressive tests of Shuttle and ELV capabilities.

Phase 2: Move, integrate, test second system in Building 13
FDF will perform operational testing with the customer community and support STS/ELV as well as standard satellites with the second system.

Phase 3: Construction/Configuration/Connectivity in Building 25/Move, integrate, test third system
FDF will move and test a third system (in Building 25) that will serve as a limited backup facility, capable of supporting the health and safety of orbiting spacecraft.

The FDF Move Team is reviewing room layouts and drafting a plan that addresses move-related issues regarding costs, schedule, and staffing. Floor plans are being finalized so that facilities subcontractors can develop estimates and work plans. Renovation of the Building 13 space is expected to begin by this fall. The FDF Move Team is working to ensure a seamless transition for the FDF customers.

By Frank Wright/CSC

For additional information, please contact Tim Thompson/ CSC via telephone (301-286-5314) or email (Timothy.W.Thompson.1@gsfc.nasa.gov).

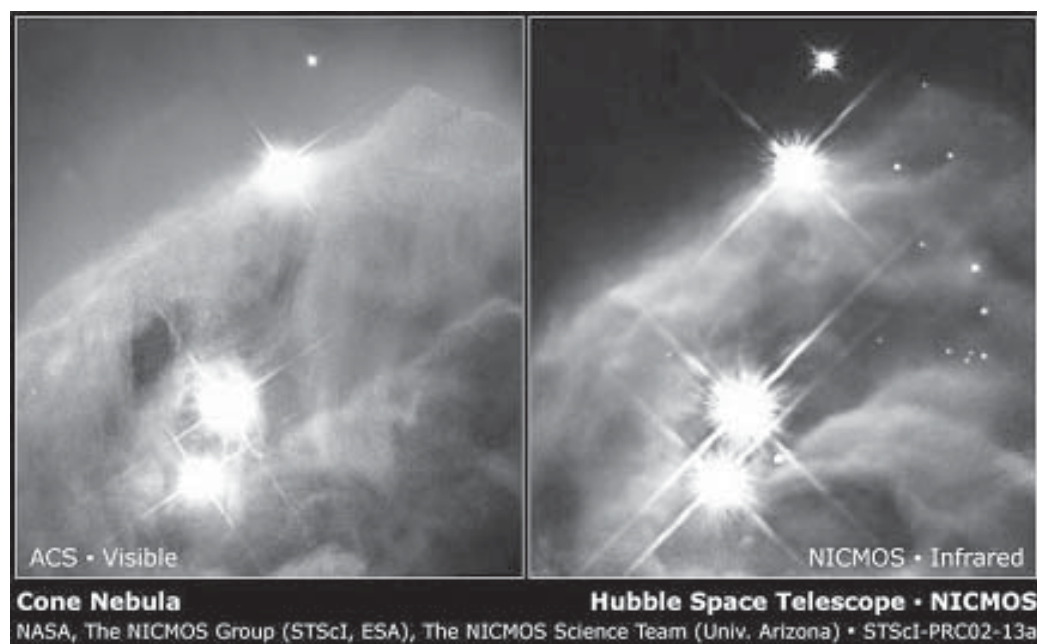
Pacor-A Level-Zero Processing System Supports HST Servicing Mission

The Pacor Automation (Pacor-A) level-zero processing system provided critical support to the Hubble Space Telescope project during the recent HST Servicing Mission 3B (SM3B) that occurred during the STS-109 mission from March 1–12. Pacor-A continued to support the mission during the Servicing Mission Orbital Verification 3B (SMOV3B) period that began on March 11. Science data processing support for the HST mission had previously transitioned to Pacor-A from the legacy systems (Generic Recording System, Pacor II, Data Distribution Facility) in August 2001.

The Pacor-A team, led by Christine Marinaccio and Bijal Patel, provided system operations, data analysis, and troubleshooting services to the HST Project to ensure that data received from HST during SM3B and the SMOV3B were received, processed, and delivered to the Space Telescope Science Institute (STScI) at the highest quality and as quickly as possible. The data were used to determine the health and safety of the science instruments, to validate the newly installed Advanced Camera for Surveys (ACS) instrument, and to checkout the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) instrument

following the installation of a new cryogenic cooling system that allowed NICMOS to once again return valuable science data following a three-year hiatus. (For more information on the HST Servicing Mission, see the article on page 9.)

And of course, level-zero data products generated by Pacor-A are also used by the STScI to produce the spectacular images that have come to characterize the capabilities of HST. The accompanying ACS and NICMOS images of the Cone Nebula, taken on May 11, 2002, are only two examples of such images.



The Pacor-A system, people, and processes worked together extremely well during this time to provide exemplary service to the HST Project, and the team is beginning to anticipate the next servicing mission, SM4, currently planned for 2004.

By Brian Repp/HTSI

Please contact the author via telephone (301-286-3699) or mail (Brian.D.Repp@gssc.nasa.gov) for more details.



Members of the Pacor-A team that supported the HST Servicing Mission 3B included (from left to right) Bijal Patel, Christine Marinaccio, and Terri Stoner

Demand Access System Development Update

The March 2002 issue of *The Integrator* provided an overview of the Demand Access System (DAS) testing schedule. This issue provides an update on the status of DAS testing and the plans for the start of DAS operations in the fall of 2002.

AES/ITT Industries of Reston, Virginia, is building DAS using a variety of COTS hardware and software, along with a customized program to tie all the various pieces together. DAS will expand Space Network Multiple Access (MA) return service capabilities by adding new receiver systems, new data configuration capabilities and monitoring tools, TCP/IP telemetry capabilities, as well as CCSDS data distribution capabilities via the NISN IONet. Consolidated Space Operations Contract (CSOC) contractors are providing systems engineering support at both GSFC and the White Sands Complex (WSC).

DAS is currently in the integration and test phase. The Test Readiness Review (TRR) was held June 26, 2002, at GSFC. Formal qualification testing begins in mid-July at the AES/ITT Industries facility in Reston, and continues for 3½ weeks. Factory Acceptance Testing (FAT) begins after the completion of formal qualification testing, and is

scheduled to finish in mid-August. DAS will then be deployed to the WSC and to the Guam Remote Ground Terminal (GRGT) for installation and Site Acceptance Testing (SAT). DAS is scheduled to transition to CSOC operations in late October 2002.

The DAS developers in Reston have recently successfully tested a simplified version of the DAS end-to-end test using a single customer. State vector propagation processes have also been successfully verified. The DAS interface to the Space Network Web Services Interface (SWSI), which will be used as the customer interface to DAS, continues to be informally tested in preparation for formal DAS-SWSI interface testing in July.

The DAS website at <http://msp.gsfc.nasa.gov/das> provides the history and goals for the project, as well as DAS documentation and ground rules that describe how customers can obtain and execute services. The DAS website also provides links to other useful sites such as the SWSI website.

Future DAS customers include Aqua, Swift, Agile, and GPM. The respective Mission Managers for these projects are working with the DAS project in preparation for becoming DAS customers.

By Tom Gitlin/GSFC Code 453

To learn more about DAS, please visit our web page at <http://msp.gsfc.nasa.gov/das> or contact the author via telephone (301-286-9257) or email (tom.gitlin@gsfc.nasa.gov)

Space Network Prepares for the Future

The Space Network (SN) is taking several proactive steps to prepare for the future of space communications via the Tracking Data Relay Satellite System (TDRSS). Near term SN upgrades include activities to expand the White Sands Complex (WSC) support for TDRSSs, modify an additional White Sands Complex Space to Ground Link Terminal (SGLT) to accommodate TDRS H, I, J services, and to automate the current WSC TCP/IP Data Interface Service Capability (WDISC) system.

To expand the ground station support capability for TDRSSs, the Extended TDRS Ground Terminal (ETGT) will be reactivated as a schedulable resource for Tracking, Telemetry and Command (TT&C) support of a TDRS at S-band. The ETGT architecture will support any of the F1-7 TDRS spacecraft or any of the TDRS H, I, J spacecraft.

SGLT-3 at WSC will be modified to allow TDRS H, I, J TT&C capabilities, and to provide additional TDRS-H, I, J customer support.

Modifications are planned for the NCC Data System (NCCDS) to enable automated scheduling of the WDISC. This automation will eliminate routine intervention by the NCC Scheduler.

In addition to the initiatives mentioned above, there are several other SN upgrades in the planning stages, as the SN endeavors to introduce new technologies to expand and improve customer services. Watch future issues of *The Integrator* for more information on these events.

By Tom Gitlin/GSFC Code 453

To learn more about these initiatives, please contact the author via telephone (301-286-9257) or email (tom.gitlin@gsfc.nasa.gov).



CODE 453

Ground Network Project

"Pinpointing and planning for the evolution of the customer market is critical to successful GN evolution."

GN Evolution Plan in the Works

The Ground Network (GN) Project is currently working to construct the GN Evolution Plan. The objective of the GN Evolution Plan is to determine a development path that will enable the GN to meet future mission customer needs, as well as Project objectives and goals in keeping with NASA's long-term best interest.

To chart a path for the future, GN Project personnel will analyze the GN environment, appraise future customer needs, examine the GN's organizational and asset capabilities, and identify and evaluate options to respond to future trends and meet future customer needs.

Current GN Evolution activity involves an examination of the GN environment to identify trends and issues that may influence the direction of the GN in the future. The evolution plan will take into consideration NASA strategic objectives, GSFC evolution plans, GSFC core competencies, and commercialization directives. In addition, initiatives and opportunities for multi-agency data service cooperation will also be examined. The evolution plan will cover external trends in technology, standards, data service market competition, commercial capabilities, and costs.

Pinpointing and planning for the evolution of the customer market is critical to successful GN evolution. To produce the Plan, GN Project staff will determine expected mission data service needs for a 20-year horizon, and then derive anticipated GN service requirements from those mission needs.

The evolution plan will also contain an assessment of GN assets, and an evaluation of the ability of the assets to meet near-, mid-, and far-term requirements. The plan will ascertain the technologies that must be infused into the GN Factory to enable the long-term architecture. In addition, the plan will examine opportunities for standardization of services that will lead to overall cost reduction.

Based on the GN environment, future mission needs, and GN capabilities, the evolution plan will determine if and how the roles and services of the GN should be changed. Technology infusion, upgrades, and architecture evolution opportunities that will enable the GN to meet customer needs will all be described. The Plan will

identify potential and desired evolution paths for the GN that enable it to support its changing customers and remain consistent with environmental trends. The evolution plan will also include a time-phased roadmap of GN elements that will provide necessary services.

The GN Project Manager will develop the GN Evolution Plan for approval by the GN Program Executive, and will revise the plan annually. Evolution Plan development activities are in progress, and a draft is planned by this summer.

By Luis Tsuji/Booz Allen

For additional information on the GN Evolution Plan, please contact Roger Clason/GSFC Code 453 via email (Roger.Clason@gsfc.nasa.gov) or telephone (301-286-7431).

TDRS Project

TDRS-J Prepares for Fall Launch

The TDRS-J spacecraft is currently scheduled for launch on a Lockheed Martin Corporation Atlas Centaur IIA launch vehicle from Space Launch Complex (SLC) 36A at the Cape Canaveral Air Station (CCAS) on October 29, 2002. The components of the Atlas Centaur IIA launch vehicle are presently being manufactured at Lockheed Martin facilities in Denver, Colorado and Harlingen, Texas. When completed, these components will be shipped to Florida in August, and assembly on the launch pad at SLC-36A will begin in early September.



TDRS-I launched on March 8, 2002 from Cape Canaveral Air Station.

The TDRS-J spacecraft is currently undergoing some final rework at the manufacturing facility in El Segundo, California, and will be flown from Los Angeles on a military aircraft to the Kennedy Space Center (KSC) in late September, where it will be placed in the Spacecraft Assembly and Encapsulation Facility 2 (SAEF-2). Boeing Satellite Systems (BSS) personnel will perform final checkout of the spacecraft and propellant loading at SAEF-2. The spacecraft will then be encapsulated in the Atlas Centaur payload fairing and transported to SLC-36A. Next, the encapsulated spacecraft will be mounted on the launch vehicle and final preparations for launch will begin.

The spacecraft to launch vehicle integration activities are pretty straightforward for TDRS-J since it is the third launch of the same spacecraft.

Some minor modifications to interface control documentation and launch procedures are currently in work.

On launch day, the Atlas Centaur will fly a standard ascent profile into a sub-synchronous transfer orbit. TDRS-J will be separated from the launch vehicle approximately 1,795 seconds after liftoff. After spacecraft separation, the TDRS-J liquid apogee motor (LAM) will be fired to perform a series of burns to insert the spacecraft into the final geo-synchronous mission orbit. After a brief period of spacecraft testing, BSS will turn the spacecraft over to the Whites Sands Control Center for comprehensive payload testing.

By Mike Goeser/GSFC Code 454

For further information about the launch of TDRS-J, please contact the author via telephone (301-286-0427) or email (mike.goeser@gsfc.nasa.gov).

TDRS Project Reaches Out

The TDRS Project funded two Education and Public Outreach activities for middle and high school students this past spring—the Botball and FIRST programs. Our project provided funding to support a team for the DC Regional Botball 2002 Tournament held May 4, 2002 at George Mason University's Patriot Center. Middle and high school students from across the region had six weeks to design,

• build and program a robot to
• compete in the tournament.
• Presented by KISS Institute for
• Practical Robotics, the
• competition was designed to
• engage students in learning the
• practical applications of
• science, technology,
• engineering, and math through
• robot-building and
• programming. Students' robots
• competed on a 4-foot by 8-foot
• game board, scoring points by
• moving colored balls into
• scoring position. Each school's
• team of two robots was
• required to turn themselves on
• and off, react to their
• opponent, and maneuver on
• the game board without the use
• of remote controls. TDRS
• Project funding helped provide
• teacher training, reusable
• robotics equipment, technical
• support, and enabled
• participation in the tournament
• for school teams.

The TDRS Project also provided funding to the Hope Chapel Academy in Hermosa Beach, CA, enabling students to participate in a series of FIRST (For Inspiration and Recognition of Science and Technology) robotics competitions. The Hope Chapel Academy High School team participated in three events in the 2002 FIRST competition: the Southern California Regional, the Silicon Valley Regional, and the national championship event in Orlando, Florida. The game for this year was called Zone Zeal, and consisted of a playing field with five different zones. Using soccer balls, robots from two



NASA/Goddard, TDRS Project Office
*Thank you for your generous support of
Hope Chapel Academy's Beach Bot 2002!*

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teams competed to score goals into specific zones. TDRS Funding for the FIRST program supported reusable robotics equipment and tools, student training and education, technical support, and student participation in the various tournaments. The Hope Chapel Academy team earned First Place in the FIRST Southern California Regional competition, where they also won the Johnson and Johnson Sportsmanship Award and the Kleiner, Perkins, Caulfield, & Byers Entrepreneurship Award. The team also earned awards in the Quarterfinals at the FIRST Silicon Valley Regional Tournament and in the Archimedes Division at the FIRST National Competition.

For more information on the Botball and FIRST programs, visit www.botball.org or www.usfirst.org.

By Laurey Adkison/GSFC Code 454

TDRS Resident Office News

The TDRS Resident Office is working very hard on both TDRS-I orbit recovery efforts and preparing TDRS-J for launch in October 2002.

Special procedures are being developed for TDRS-I orbit correction. The propulsion subsystem of TDRS-I is being exercised in unique and innovative ways to utilize the on-board fuel to ultimately achieve the intended geosynchronous orbit.

· In the Integration and Test
· Complex (ITC) at Boeing
· Satellite Systems (BSS), TDRS-
· J testing continues with
· emphasis on Flight Final
· preparations. Special Risk
· Assessment activities have
· been ongoing since the TDRS
· I problem became apparent

· It is with much sadness that we
· report the passing of Willie
· Bostic, our NASA/TDRS
· Resident Office Quality
· Assurance expert. On
· Thursday evening June 13,
· 2002, Willie lost his brief battle
· with cancer. All of us in the
· Resident Office and everyone
· on the TDRS Project who knew
· him will miss Willie very much.

By Paul Nordin/GSFC Code
454

Have questions about the TDRS Project?



Be sure to visit the web site for more information about the program, spacecraft, schedule, and much more.

The TDRS Project web site can be found at:
<http://tdrs.gsfc.nasa.gov/tdrsproject/>



Crosscutting Activities

GSFC Personnel Participate in CCSDS Activities

The Consultative Committee for Space Data Systems (CCSDS) is an international organization, whose members seek to exchange technical information regarding common space data transport and information interchange problems. CCSDS members work to agree upon optimized solutions (called CCSDS Recommendations) to such problems, and to promote the implementation of these solutions. In addition, CCSDS Recommendations are established and approved as ISO international standards.

In this article, we summarize the recent CCSDS activities of GSFC personnel.

Members of *Panels 1A/1F (Protocols/Advanced Orbiting Systems)* wrote an Executive Summary for Space Packet Protocol Green Books giving readers a quick sketch of what each protocol provides. These members also completed testing of the Linux version of CCSDS Ground Telecommand software, which passed all tests. [Technical Representative Tim Ray/GSFC Code 584]

Panel 1C (Data Compression) has been investigating image compression schemes, and is currently working toward a common solution for a single recommendation. The final selection of a candidate will depend on cross-verification of algorithm performance, which requires exchange of software between agencies. Panel members completed a paper for presentation at the Space Ops Conference 2002, providing a history of the technology development that supported the effort to standardize a lossless data compression algorithm, along with recent technology evolution and examples of known mission implementations for space applications and ground archive use. This Recommendation has benefited many space missions by either reducing bandwidth, onboard storage requirement, or by increasing science data return. [Technical Representative Pen-Shu Yeh/GSFC Code 564]

Panel 1E (Modulation) achieved international consensus to simplify the data format for the uplink and modulation Recommendations. This simplification was proposed in support of the smaller satellite projects as an effort to reduce the power,

weight, and size need for telecommand. [Technical Representative Wai Fong/GSFC Code 564]

Panel 1J (Navigation) completed an internal panel review of the Orbit Data Messages Red Book, and distributed the document for CCSDS agency-wide review. Following this review, this Recommendation will be formalized. [Technical Representative Felipe Flores-Amaya/GSFC Code 453]

Panel 2 (Standard Information Interchange Processes) members were the main drivers behind the recent CCSDS/Technical Steering Group Extensible Markup Language (XML) workshop that took place April 3-5, 2002 in the United Kingdom. The thrust of this meeting was to continue leveraging the XML standards and software, and identify and establish standards for an information infrastructure. This infrastructure is to support specific interface standards that make use of standardized registries of information and software (including data entity dictionaries) to facilitate mission operations and data understanding needed by NASA and other agencies.

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Recommendations from the workshop included a call for a demonstration of an initial infrastructure and its application to support the exchange of messages requesting Space Link Extension (SLE) services. Action on this recommendation depends on the provision of new resources from several agencies including NASA.

During its main workshop that took place April 8-12 in the United Kingdom, Panel 2 significantly advanced its work on an XML-based data packaging approach. This approach is required to package together (in a single file) several data objects with associated metadata and relationship information. A draft White Book is scheduled for production in July 2002. Also advanced was the White Book entitled the "Producer-Archive Interface Methodology Standard," which is essentially a checklist to reduce costs and improve the automation between projects and multi-mission archives. The next version for review is expected at the end of June 2002. [Technical Representative Donald Sawyer/GSFC Code 633]

During the Spring Panel 3 (Cross Support Operations) Workshop held in Oberpfaffenhofen, Germany, NASA made a proposal to redirect the SLE Service Management (SM) work. The European Space Agency (ESA) strongly supported this proposal. Essentially, in response to the Agency review of the SLE SM Red-2 document suite, NASA proposed that the Service Management activity be severely descoped in the interest of producing a recommendation that will be simple, usable, and available in a short time. Basically, the SLE-SM Service Request (SR) XML Book will be one concrete specification documented with XML (Other mappings - e.g., Java RMI - may be considered later).

The XML Specification will be developed to support requirements for Tracking, Telemetry and Command (TT&C) operations. Service Requests will be addressed in the initial version of the book (real-time reconfigurations and monitoring may be added eventually). Operational Requirements for TT&C Services include the major sequence of interactions between the Utilization Manager (UM) and Command Manager (CM), and consider the Service Agreement (years in advance), Schedule contacts (months to weeks in advance), Submission of trajectory data (weeks to days in advance), Submission of SLE Service Packages (weeks to days in advance), SLE Service Package execution, and Post Pass Report (some time after end of service package execution).

Items for further study and definition are included in the specifications. Data to be transferred across this interface will include spacecraft communications configuration and link requirements; ancillary data (trajectory data); spacecraft communications operating modes and planned events; spacecraft

contact information, times, modes, events, and contact specific overrides; and abstracted specifications of service provider interface configuration information. The SLE-SM/SR XML Book will be the concrete specification for Service Requests that use XML. [Technical Representative James Pritchard/GSFC Code 586]

For further information, please contact Felipe Flores-Amaya, GSFC Data Standards Manager (301-286-9068), or visit the CCSDS web pages (<http://www.ccsds.org>).

DSMC Space Network Transition Complete

Implementation of the Data Service Management Center (DSMC) at the White Sands Complex (WSC) progressed significantly during the first half of 2002. Transition of the DSMC Network Control Center Data Systems (NCCDS) for the Space Network (SN) occurred on June 25. DSMC personnel completed the necessary testing, accomplished the required training, published the cutover timeline, and were poised and ready to execute the transition upon completion of the STS-111 mission and the NOAA-M launch on June 24.

The DSMC operations personnel, however, were not sitting idly by, waiting for the cutover. They had conducted operations (remotely connecting to the NCCDS) for several months prior to the transition, earning praise regarding their support from NASA Human Space Flight (HSF) and Aqua.

A successful Operational Readiness Review (ORR) for this transition was held on June 11 at the White Sands Complex (WSC), with excellent customer participation from HSF, Aqua, Terra, SP&M, the Hubble Space Telescope, the Tropical Rainfall Measuring Mission, Landsat-7, Landsat-5, the Earth Radiation Budget Satellite, and the Upper Atmosphere Research Satellite. While the customers were at the WSC site in New Mexico, they participated in a tour of the site, and managers presented a plaque to the DSMC operations team recognizing the commencement of Ground Network (GN) and SN management operations.

Future activities for the SN include transitioning the Auxiliary NCC (ANCC) to WSC on October 9. In preparation for that event, we will be contacting SN customers and asking them to participate in engineering interface testing in the August-September timeframe.

Special thanks go to the NCC personnel that supported testing and training for the DSMC project; their contributions were key to the successful completion of this critical milestone. NCC staff members have also continued to ensure strong and effective

network operations, and as the NCC's mission at GSFC comes to a close, these folks can certainly be proud of the work they have accomplished.

For the GN, the DSMC has continued to successfully schedule the GN legacy assets (LEO-T, TOTS, 7.3M) since October 24, 2001, and on May 6 we held an ORR to transition the 9M scheduling (including Shuttle scheduling and support of the customers that use the 9M on an emergency/contingency basis). The transition was completed on May 9 and scheduling of the STS-111 mission went well.

We are still working on the GN Automated (11M) parallel operations scheduling activities, and are endeavoring to ensure all inputs are received. The operational transition for this function is now targeted for August 5-26, with an ORR scheduled on July 18.

By Cathy Barclay/HTSI

For additional information on this topic, please contact the author via email (Cathy.Barclay@gsfc.nasa.gov) or telephone (301-805-3221).



Don Shinnars accepts a plaque recognizing the DSMC operations commencement at the White Sands Complex. Pictured left to right are Jim Gavura/WSC Station Direction, Steve Sypher/WSC Operations Manager, Bob Hudgins/DSMC Operations Lead, Don Shinnars/CSOC SN Project Manager, Cathy Barclay/DSMC Project Manager, and JoAnn Sidotti/DSMC Deputy Project Manager.

Search and Rescue Technology Insertion

The National Search and Rescue (SAR) Plan states that "NASA supports SAR objectives through research and development or application of technology to search, rescue, survival, and recovery systems and equipment, such as location tracking systems, transmitters, receivers, and antennas capable of locating aircraft, ships, spacecraft, or individuals in potential or actual distress." Goddard's Search and Rescue Mission Office researches and develops this technology for NASA. This technology not only saves lives, but also diminishes risks to rescue personnel and reduces the search costs.

The highly successful SARSAT (Search and Rescue Satellite-Aided Tracking) beacon-locating satellite system was developed at Goddard, and is now managed by the National Oceanic and Atmospheric Administration (NOAA). The international COSPAS-SARSAT system has saved more than 13,000 lives (COSPAS is an acronym for the Russian words meaning "Space System for the Search of Vessels in Distress"). However, the on-board Emergency Locator Transmitter (ELT) on crashed aircraft fails to operate 75% of the time. Thus, the Search and Rescue Mission Office has been investigating the use of synthetic aperture radar to locate crashed aircraft whose beacons have failed to operate. This technology insertion candidate for Search and Rescue is funded under the Space Communications and Data Systems (SCDS) Technology Development Program at Goddard. Previously, SOMO (Space Operations Management Office), the predecessor to SCDS, had provided funding as part of NASA's commitment to the National Search and Rescue Plan.

The FY '02 goals of this program are to develop algorithms to screen out clutter and other natural features; to reduce the processing time of locating potential crashed aircraft; and finally, to develop specifications and a design for an airborne Search and Rescue Synthetic Aperture Radar (SAR²). This effort is part of the five-year agreement between NASA and the National Association for Search and Rescue (NASAR) to investigate remote sensing technology for application to Search and Rescue. This agreement was signed in November of 2001.

Attainment of these goals has been focused on analysis of data from this year's experiment in the San Bernardino Mountains near Los Angeles, California. On the evening of April 1, thirty-nine flight passes were made over the mountains by the NASA DC-8 based at Dryden Flight Center. On board was the Airborne Synthetic Aperture Radar (AIRSAR), a research instrument managed by JPL and temporarily utilized for this experiment. The planned flight lines are shown in Figure 1 (on page 30).

(continued on page 30)

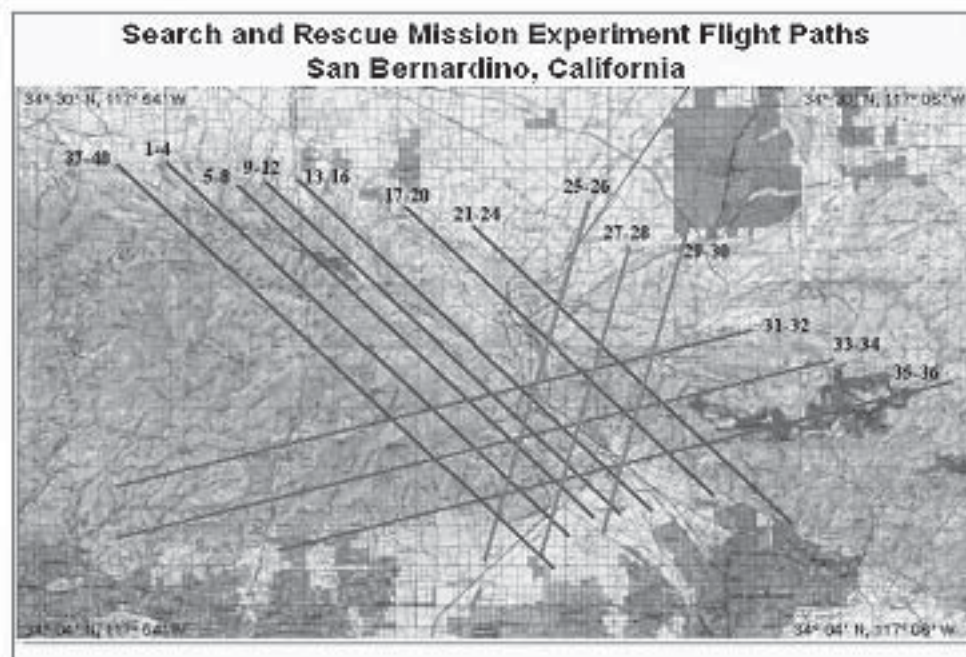


Figure 1 - Planned experiment flight pattern

(continued from page 29)

Each flight line produced enough raw data to image a 6 km. wide by up to 40 km. long swath of terrain both at L-band and P-band. The raw data provided fully polarimetric complex scattering matrices of the image pixels, achieving a resolution of 1.5 meters by 2.5 meters. P-band has the capability of penetrating foliage, and both bands yield imagery at night, through fog or inclement weather.

Prior to April 1, the San Bernardino County Sheriff's Department (SBCSD) assisted a small team from the Search and Rescue Mission Office in placing precise metal targets and four simulated crashed aircraft in the mountains. Figure 2 shows one of the simulated crashes.



Figure 2 - Simulated crash site

These targets were carefully surveyed for ground truth using GPS equipment and expertise provided by Dr. George Rogers of the Naval Surface Warfare Center. In addition, Mike Tuttle, the President of NASAR and SBCSD's Lieutenant Sheriff in charge of volunteer forces, identified prior aircraft crash sites and provided information on an unresolved crash.

Some preliminary radar images have been processed from this experiment. Although not optimized for the crash target recognition algorithms developed by the Search and Rescue Mission Office, these images do show calibration targets and at least one simulated crash site. (To view one of these images, please refer to the web-based version of this article at (<http://msp.gsfc.nasa.gov/integrator/xcut.htm>). The Search and Rescue Mission Office will optimally process the raw data from this experiment and develop a final list of candidate crash sites by late summer. In the meantime, a preliminary list of potential crash sites has been given to Mike Tuttle based on the initial images. Look in the next issue of *The Integrator* to find more about how this newly applied technology performed in this experiment.

By Rudy Larsen/ Search and Rescue Mission Office/GSFC Code 567

For further information contact the author via telephone (301-286-6016) or email (Rudolph.K.Larsen.1@gsfc.nasa.gov).



New Space Network Users' Guide Available!

Revision 8 of the Space Network Users' Guide (SNUG) is now available online. In addition to information about Tracking Data Relay Satellites 1-7, the new version contains information on:

- The latest Space Network Architecture
- TDRS H, I, J
- The Demand Access System
- The McMurdo and South Pole Relays
- Spectrum issues that may affect Space Network customers.

To access the SNUG online, please follow the following procedure:

1. Go to URL <http://gdms/gsfsc.nas.gov>
2. Click on the "Guest" button
3. Click on the "Centralized Configuration Management System" button
4. Click on "Document Library"
5. Select the Flight Program and Projects Directorate (Code 400)
6. Search for the Specific Document Number 450-SNUG

Another link to the revised SNUG will be provided shortly from the Space Network Online Information Center at:

<http://msp.gsfsc.nasa.gov/tdrss/guide.html>

A limited number of hard copies will be made available to those that require them in their daily activities. If you would like to receive a hard copy, please contact Frank Stocklin via email (frank.stocklin@gsfc.nasa.gov) and provide him with an explanation of your needs.



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can be accessed online at
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Previous issues of this publication can also be found online
in *The Integrator* Archive.

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